REMARKS

Claims 13 to 15, 18, 19, 21 to 24, and 25 to 30 are pending in this patent application. Claims 1 to 12, 16, 17, and 20 have been canceled without prejudice.

Claims 13 to 15, 18, 19, and 21 to 24 are currently amended. Claim 13 was amended to more clearly define Applicants' claimed invention. Claims 14, 15, 18, 19, and 21 to 24 are amended to correct their dependency.

Claims 25 to 30 are new. Support for these claims can be found, for example, in the Specification at paragraph [0024] and in the original claims. No new matter has been added.

The Action includes rejections under 35 U.S.C. § 103. In view of the foregoing amendments and the following remarks reconsideration and withdrawal of the rejections are respectfully requested.

Discussion of Objections Under 37 C.F.R. § 1.75(c)

Claims 23 and 24 are objected to as allegedly failing to further limit the subject matter of a previous claim, particularly Claims 13 and 19, respectively. In view of the foregoing amendments, Applicants submit respectfully that the objection to Claims 23 and 24 are now moot.

Discussion of the Rejections Under 35 U.S.C. § 103(a)

Claims 13 to 16 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. patent application Publication No. 2004/0132308 to Obeng et al. ("Obeng"); Claims 14 and 15 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Obeng in view of U.S. Patent No. 6,063,306 to Kaufman et al. ("Kaufman"); Claim 16 is rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Obeng in view of Kaufman and further in view of U.S. Patent No. 5,750,440 to Vanell et al. ("Vanell"); and Claims 19, 21, 22 and 24 are rejected as allegedly being unpatentable over Obeng in view of Kaufman and further in view of U.S. Patent No. 6,300,249 to Yoshida et al. ("Yoshida"). Applicants respectfully traverse these rejections because (1) Obeng is not prior art to the present invention with respect to the particular disclosure relied upon by the Action; and (2) one of ordinary skill in the art presented with Kaufman, Vanell, and Yoshida at the time of the present invention would not have been motivated to modify or combine their teachings in such a way as to obtain Applicants' claimed invention.

A. The Claimed Invention

Applicants' claimed invention defines a chemical mechanical polishing ("CMP") mixture comprising, in part, a plurality of particles having an average particle diameter ranging from 500 to 2000 μm, and optionally a void volume ratio of less than about 1. Applicants have surprisingly found that CMP mixtures with large, preferably non-abrasive, particles advantageously remove excess copper material from a semiconductor substrate without causing defects such as dishing or scratches in the underlying dielectric layer.

The size of the particles in Applicants' polishing slurry is an important aspect of the claimed invention beause it impacts the slurry's polishing performance. For example, if the particles are too small, they cannot deliver enough impact energy to the surface and, thus, the mechanical action becomes too weak to effectively remove chemical reaction products. On the other hand, if the particles are too big, the opposite occurs – *i.e.*, the mechanical action becomes too strong that it can make scratched on flat silicon oxide surfaces. Applicants have found that superior polishing is achieved using particles that preferably have an average diameter from about ***500 to about 2000 μm***.

B. The Obeng Reference

The Office alleges that Obeng teaches a plurality of particles having an average particle diameter size of less than 1000 µm, which allegedly overlaps applicant's claimed range of 500 to 2000 µm (Action at p. 2 to 3). Applicants assert that this disclosure in Obeng is not prior art to the present invention. More particularly, Obeng has a filing date of October 14, 2003, which does not predate the filing date of the present application (*i.e.*, October 2, 2003). Thus, the disclosure of Obeng itself is not prior art to the claimed invention.

Applicants acknowledge that Obeng claims priority to earlier applications U.S. Serial No. 10/000,101 (filed October 24, 2001, "the 101 application"); U.S. Serial No. 10/241,074 (filed September 11, 2002, "the 074 application"); and U.S. Serial No. 60/420,371 (filed October 22, 2002, "the 371 application") (*see* Exhibits A, B, and C, respectively). However, not one of these earlier filed applications teaches, either explicitly or implicitly, particles having an average particle diameter ranging from ***500 to 2000 µm***. Contrary to teaching a slurry comprising large diameter particles (i.e., 500 to 2000 µm), the 371 application teaches a slurry comprising "abrasive prticles having a diameter of less than about 100 nanometers" (i.e., < 0.1 µm) (*see* Exhibit A at paragraph [0007]). With respect to the 101 and 074 applications, not only do these applications fail to teach a slurry comprising an average particle diameter ranging from 500 to 2000 µm, but also ***fail*** to teach the presence of ***any*** particles (*see* Exhibits B & C). Since Obeng is incapable of teaching or suggesting Applicants' claimed invention, the Action's reliance on Obeng is misplaced. Accordingly, the rejection of Claim 13 should be withdrawn.

C. The Kaufman Reference

The Action alleges that Kaufman teaches a polishing slurry comprising from about 3 to about 45 % solids which the Action alleges "would provide a solution of void volume ratio of about one" (Action at p. 3). Applicants respectfully disagree because Kaufman does not teach a void volume ratio as presently claimed. Instead, Kaufman teaches a slurry having a ***solid weight percent*** range of abrasive particles.

As explained in the attached Affidavit by Dr. Seong Kim, one of the inventors of the claimed subject matter, a "void volume ratio" means the "ratio of solution volume to the void volume of the particles" (Kim Dec. at ¶ 6). More particularly, the void volume ratio of a slurry is a correlation between the liquid volume of the slurry and the *volume of space* that exists *between solid particles* of the slurry (id. at ¶ 8). The void volume ratio, therefore, is not derived on the volume of the solid particles *per se*, but instead is derived from the volume of space that is created between such solid particles (id.). This volume of space is dependent upon the geometry of the individual particles, their packing density, etc. (id.). Thus, contrary to the Examiner's interpretation of void volume ratio as relating to a correlation between the volume of a solution and the volume of solid particles in the solution, the term void volume ratio means the ratio of the liquid solution volume to the volume of space existing between the particles.

As indicated above, Kaufman teaches a polishing slurry having a particular weight percent of abrasive particles – not a slurry having a void volume ratio (*see* Kaufman at column 10, lines 39 – 43, and Examples 1, 2, and 3). In fact, Kaufman does not even teach is the volume ratio of any slurry components, let alone void volume ratios. Even if (*arguendo*) one skilled in the art could estimate the relative volume percentages of solids to liquids in the slurry based upon the weight percentages taught by Kaufman, it would still be impossible to determine the void volume ratio of such slurry. Indeed, it would be impossible to determine the void volume ratio of such slurry because, at least in part, the void volume of a sample of particles is dependent upon the geometry of the individual particles, their packing density, etc. Kaufman is completely ***devoid*** of such information. Thus, considering the actual meaning of void volume ratio, it is clear that Kaufman does not teach or suggest this aspect of the invention. In view of the teachings of Kauman and the absence of Obeng as a prior art reference, reconsideration and withdrawal of the rejections of Claims 14 and 15 are requested respectfully.

D. The Vanell and Yoshida References

As noted above, Claim 16 is rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Obeng in view of Kaufman and further in view of Vanell. Although Applicants disagree with the rejection of Claim 16 because the combination of Obeng and Kaufman does not teach each and every recitation of independent Claim 13, Applicants have nonetheless cancelled Claim 16, thus rendering moot the rejection.

Claims 19, 21, 22 and 24, however, are rejected as allegedly being unpatentable over Obeng in view of Kaufman and further in view of Yoshida. As detailed above, however, the combination of Obeng and Kaufman does not teach each and every limitation of Applicants' claimed invention defined by independent Claim 13. Accordingly, even if Yoshida did teach or suggest the limitations of dependent Claims 19, 21, 22 and 24 (*arguendo*), such combination is still incapable of teaching or suggesting each and every limitation of Applicants' claimed invention. Accordingly, reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a) is requested respectfully.

Conclusion

Applicants believe that the foregoing constitutes a complete and full response to the Action of record. Applicants respectfully submit that this application is now in condition for allowance. Accordingly, an indication of allowability and an early Notice of Allowance are respectfully requested.

The Commissioner is hereby authorized to charge the fee required and any additional fees that may be needed to Deposit Account No. 01-0493 in the name of Air Products and Chemicals, Inc.

Respectfully submitted,

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